ACTIVITY 17

THE BUSINESS OF CLEAN AIR

This activity uses a structured discussion with the class to help educators introduce the concept that air pollution control is caused by a combiNation of market incentives and government regulation. While nobody "likes" air pollution, or causes it intentionally, there are tradeoffs associated with pollution control. Businesses are motivated by profit, and will change their way of doing business if they can see a demonstrated benefit. This activity is related to the warm-up called "Making Decisions." Related activities include "The Greenhouse Effect," "Climate and the Greenhouse Effect," and "The Cost of Polluting."

CRITICAL OBJECTIVES

- Realize that businesses exist to make profits for their owners
- Recognize that governments make rules for individuals and businesses in order to establish minimum standards to protect society (human health and well being, ecology)
- Understand that businesses change as a result of market forces and regulations
- Appreciate that pursuing environmental concerns and realizing a profit can be competing objectives for a business
- Realize that pursuing environmental concerns and realizing a profit can be complementary objectives for a business

SKILLS

- Observing
- Collecting data
- Computing

GUEST PRESENTERS

Guest presenters for this activity could include air quality engineers, business administrators, economists, industrial engineers, lawyers, or mechanical engineers.

BACKGROUND

Air pollution in this country is largely a result of business decisions, set in motion many years ago, that emphasize profit without balancing environmental concerns. In the 1960s, the federal government began to regulate pollution. The Clean Air Act was one of the first laws intended to govern the release of certain pollutants into the atmosphere. In recent years, many businesses have embraced the "green" approach to marketing, recognizing the image value of environmen-

RELATED WARM-UP
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REFER TO READING MATERIALS
"The Greenhouse Effect"
"Air Pollution"

TARGET GRADE LEVEL
8th - 12th

DURATION
1 or 2 45-minute class periods, depending on the depth of discussions

VOCABULARY
Amortization
Capital costs
Kilowatt-hour
Lumens
Market forces
Mitigation
Pollution
Power consumption
Profit
Regulations

MATERIALS
Chalk
Chalkboard

WORKSHEETS INCLUDED
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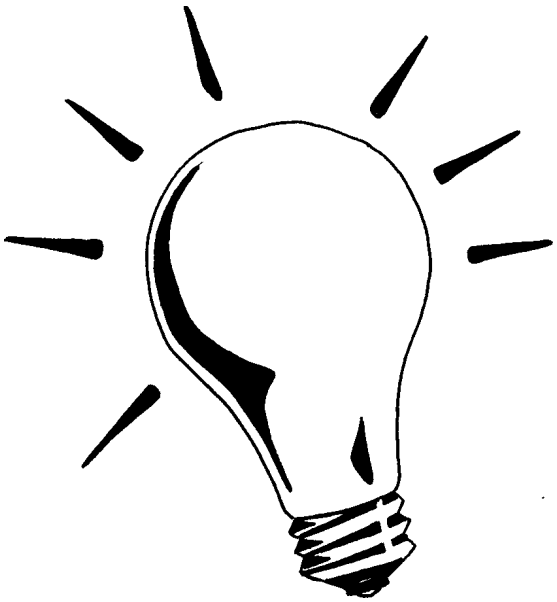
tal consciousness. However, the primary motivation for business is to make a profit.

Pollution control and environmental improvement is big business. An estimated $115 billion is spent annually on environmental protection. The federal government will spend $1.9 billion during the six-year period 1994-2000 to implement its *Climate Change Action Plan*. This plan, which is expected to save the government $2.7 billion during that same period, is designed to slow the greenhouse effect, reduce air emissions, and stimulate the economy.



EPA and other organizations have instituted voluntary compliance programs using the "penny-saved, penny-earned" principles of business to encourage wholesale improvements in energy efficiency and waste minimization. Such initiatives as the "Green Lights" program, which encourages businesses to cut back on electric lighting, are estimated to have a potential National savings of $16 billion in electricity bills and reduce carbon dioxide, sulphur dioxide, and nitrogen oxides (the principle ingredients of air pollution and smog) by 12 percent, thereby slowing the greenhouse effect. What's in it for business? The obvious answer is significantly reduced costs of operation, providing capital for new jobs and increased productivity. In addition, in return for signing an agreement with EPA to upgrade its lighting, a business will receive technical advice, free publicity, and possible financial support. EPA's newer "Energy Star" program is a sequel, encouraging business to improve energy efficiency throughout the building—beyond just installing energy-saving light bulbs. (See the reading materials called "The Greenhouse Effect" and "Air Pollution.")

WHAT TO DO

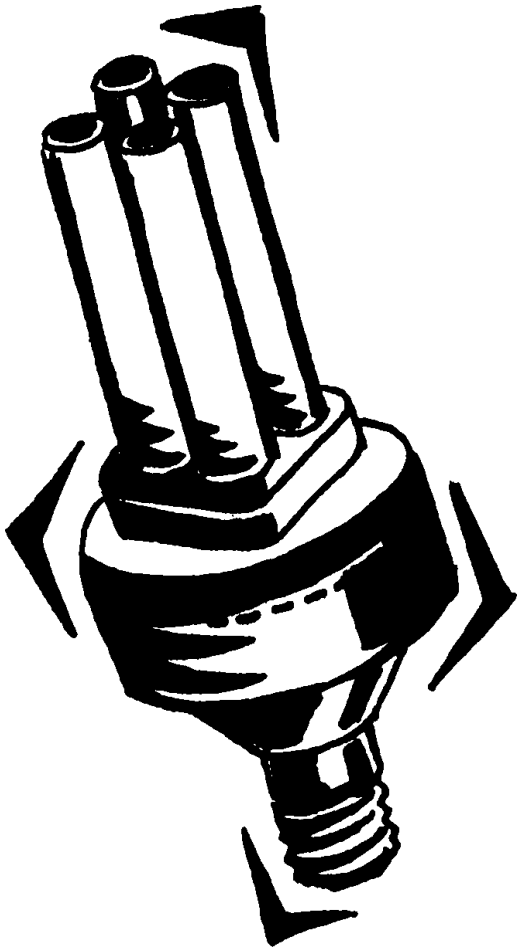
1. Tell the class to consider all the reasons why air pollution exists, why it isn't cleaned up, and what the possible roles of government, the public, and businesses are as forces in the issue. Write the responses on the chalkboard. Suggest that someone volunteer a couple of industries that might be associated with air pollution. (Common examples might be electric power generation, pulp and paper manufacturing, or oil refining. Less common, but also good, examples are surface mining (dust), steel manufacturing (coke/coal burning), agriculture (dust and chemical aerosols), or airlines (fuel vapors and exhaust).

2. As one example of how businesses can contribute to reducing air pollution, tell the class about EPA's voluntary "Green Lights" program. This program encourages businesses to conserve electricity by identifying and implementing lighting upgrades in their buildings wherever

it is "profitable" within five years. "Profitable" means, in this case, that the savings are greater than about six percent per year. In return for their participation in the program, EPA helps businesses obtain the most current information about energy-efficient lighting technologies, assists them in deciding which technologies are best for them, and provides guidance on how to finance the upgrades.

3. Explain that, for the purpose of this activity, students are to pretend that the school building is a commercial business building. Have them identify any "costs" to the "business" involved in conserving electricity that might offset any savings realized. For example, shutting down the school totally, while a popular suggestion that would certainly save electricity, would prevent the school from conducting its business. Ask the class to identify the beneficiaries of this "profit." Ask them to identify the secondary effects if such a practice were really implemented widely in their community (less generation costs, fewer brownouts, less pollution, less fuel used to produce electricity, etc.)

Energy efficiency is based on "getting something for nothing." For electric lighting, we want to obtain the same level of light (usually measured in lumens) for less consumption of power (usually measured in watts). The student worksheet called "Light Conversion" is formatted for conversion of incandescent lights to compact fluorescents, but the same principle applies for replacing older, low-efficiency fluorescents with high-efficiency fluorescent lighting. The same principle applies in turning off electrical devices when they are not in use, such as computers, televisions, air conditioners, and motors.



4. Hand out the worksheet. Divide the class into workable groups to identify all the electric lights in the school. The groups should look at common rooms such as the auditorium, gym, and cafeteria as well as the classrooms. The teacher may wish to assign certain rooms or locations to different groups to check at a time when rooms are not occupied by students. Students should not overlook spotlights or floodlights. Have the class compile a list of electricity reductions that could be accommodated within the school. For each reduction, have them identify what the potential savings could be, or at least how they could measure the savings. Get them to talk about the need to invest money up-front (for example, replacing incandescent lamps with fluorescent ones) in order to realize a long-term payback.

5. It obviously costs money to buy more energy-efficient equipment, even lightbulbs. In order to determine the true savings of such devices, have the class calculate a "payback" period for some devices. For example, a 60-watt bulb costs 89¢ and will last for 1,000 hours. A 13-watt compact replacement tube costs $6, but will last 10,000 hours. What is the savings, and what is the payback period? Explain to the class about two types of costs: *capital costs* and *operating costs*. *Capital Costs* are costs involved in purchasing or building something that is necessary to have. For example, a business's capital costs include the purchase prices of the furniture and equipment needed to provide the services or produce the goods it sells. Capital costs are usually divided by the expected life-span of the equipment to get an annualized cost. *Operating Costs* are the day-to-day costs involved in providing the services or producing the goods. For example, the total cost of transportation includes buying a car and then keeping it running. The capital (one-time) cost might be $15,000. If the car is expected to last 5 years, the annualized capital cost would be $3,000. Operating (recurring) costs include gasoline, oil, tires, insurance, normal repairs, and anything else needed to keep it running.

6. Have the class calculate the payback period of investing in high-efficiency light bulbs to replace existing bulbs throughout the school.

   Purchasing one high-efficiency tube requires a capital investment of $16, but lasts as long as 10 of the 89¢ bulbs.

   To obtain 1,000 hours of light from the incandescent bulb, it costs:
   60 watts x 1000 hours ÷ 1000 = 60 kilowatt-hours x 8.5¢/kWh =
   $5.10 (operating cost) + $0.89 (capital cost) = $5.99

   To obtain 10,000 hours from the high-efficiency bulb, it costs:
   13 watts x 10,000 hours ÷ 1000 = 130 kilowatt-hours x 8.5¢/kWh =
   $11.05 (operating cost) + $16.00 (capital cost) = $27.05

   Put another way, it will have cost us about $60 to obtain the same lighting from 60-watt incandescent bulbs as we could get for about $27 from one compact fluorescent tube.

   For example, the chart below shows the costs for each type of bulb measured against hours of use. While the compact fluorescent costs more to start, its lower operating costs allow the incandescent bulb to catch up and become more expensive after about 3,100 hours of use. This "payback" graph shows how long it will take to amortize the higher

capital cost of the fluorescent. If we use about 250 hours per month, our payback time will be about 12.4 months or just over one year.

7. Compile the "Green Lights" suggestions and audit results and forward them to the Principal and the School Board with an explaNation of how and why they were developed.

SUGGESTED EXTENSIONS (OPTIONAL)

☼ Organize the class into several groups. Each will role-play a particular segment of business or industry. The groups could include: the local electric power utility, the local car dealer, a major local industry (let's say an airplane manufacturer or shipbuilder), and the local downtown business council. Tell them that their community is in danger of violating the federal and state air pollution standards for hazardous air pollutants. No one knows where the pollutants are actually coming from, but it is known that they exist in the aircraft/shipbuilding industry and as a by-product of automobile and truck emissions.

Have each group write down a list of actions that should be taken by each of the groups and the reasons why. Instruct them to focus on the actions that their own group should take first, then the others. The groups should work independently, and should not exchange views until the end. Caution the groups that they should anticipate the actions that they think the other groups will expect them to take and be prepared to explain (defend) their choices. This activity could take portions of several days, or be done as homework over a weekend.

When the groups are ready, have them present to the class their "action plans" to solve the problem. Write down the key actions for each group on the chalkboard. Have the class compare and discuss them.

- Have students find a large business in your community that has an energy-conservation program in place like "Green Lights." Select a team of students to contact the company and ask them for data and computations on the savings they are realizing. Ask how the company is investing the savings realized from lower electricity bills. Have the students report back to class and discuss the information obtained.

- Does your local utility ever have a "brownout?" A "brownout" is when the power company reduces the line voltage from the normal 110 to 90 or even 80 volts. Most household equipment will work at the lower voltage. Have students contact the local power company and ask why and when the power company uses "brownouts?" Does this save wattage? How much?

- Have selected students contact a lighting supplier or lighting contractor (look in the *Yellow Pages*) and ask them for pricing data and specifications for "T-8 Lamp-ballast upgrades" for the standard 40-watt fluorescent tube systems in your school. Based upon the number of fixtures and the number of lamps, have the students calculate the annual savings in operating costs and the payback period for the conversion, taking into account the initial capital investment for the new lighting.

SUGGESTED READING

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Nelson-Horchler, Joani. "Greening or Greenwashing? Industry Efforts Get Praise and Punches." *Industry Week*, 239 (16 April 1990) p. 77.

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U.S. EPA. *Green Lights: An Enlightened Approach to Energy Efficiency and Pollution Prevention*. Washington, DC: U.S. EPA, Office of Air and Radiation EPA/430/K-93/001 (July 1993).

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STUDENT WORKSHEET 1
THE BUSINESS OF CLEAN AIR
LIGHT CONVERSION